

### A.4.15 AOC 16

#### Description

The OWSS (AOC 16) consists of approximately 11 miles of underground piping that connects the tank basins and process areas to the ETP. The OWSS, which was constructed prior to 1950, is used to convey process water and stormwater runoff from process areas and tank basins to the ETP that is located in the North Field. The OWSS in the North Field/Main Yard and Central Yard flow to the ETP via gravity. Process water and stormwater collected in the East Yard are pumped to the ETP.

The OWSS has been the subject of two major investigations. These include:

- *1st-Phase Oily Water Sewer System Investigation Report RCRA Corrective Action Module #3*. (Chevron, September 1997); and,
- Phase II OWSS Investigation – (March 2002).

The sampling strategy during the 2nd-Phase OWSS was modified to target potential groundwater impacts. One groundwater sample was collected at each of the proposed sampling points, and soil samples were to be collected from the vadose zone if evidence of environmental impacts was observed. Groundwater samples were obtained from the first water-bearing zone using NJDEP's Alternate Groundwater Sampling Technique 4.0. Samples collected for VOC or SVOC analyses were collected using a bailer after slotted PVC was driven to depth. Porous media and a peristaltic pump were used to collect samples to be analyzed for metals.

As summarized in Table A.4.12, a large number of samples (approximately 70 soil samples and 250 groundwater samples) were collected and analyzed as part of the two OWSS Investigations<sup>1</sup>. The results are discussed in detail in the two reports referenced above. In addition, soil samples were collected from monitoring wells that installed during the Full RFI. Some of these monitoring wells were primarily installed to investigate site-wide groundwater flow and are not necessarily located near SWMUs and AOCs (including the AOC 16 OWSS sewers), but in some cases they were specifically installed to confirm findings from the OWSS Investigations. The six OWSS segments in the East Yard (EY1 through EY6) are depicted on Figures A.4.12a through A.4.12f. A summary of findings for each segment is provided below.

#### EY1

Investigation Area EY1 is located in the northern portion of the East Yard tank field, an area that is primarily composed of ASTs and petroleum product pipeways. The following samples have been installed to evaluate potential releases from the EY1 OWSS segment:

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<sup>1</sup>Relevant data from nearby SWMUs, AOCs and PAOCs are not included on Table A.4.12 because of the large number of samples that are already summarized on Table A.4.12, and because the six East Yard OWSS segments encompass the entire East Yard. Sections 6 and 8 of the RFI Report contain a broader overview of soils and groundwater respectively.

Constituents of Concern	Phase I OWSS		Phase II OWSS		Full RFI	
	Soil	Water	Soil	Water	Soil	Water
VOCs	12	13	3	4	10	4
SVOCs	12	13	3	4	10	4
Metals	12	13	3	4	10	4
TPH	12	13	0	0		
GC Fingerprint	0	0	0	1		
Water quality						4

Measurable LNAPL was detected in only one boring (H0451). This area is part of LNAPL area EY1, which straddles the EY1/EY3 border, immediately southwest of Tank 767. This LNAPL area is discussed in more detail in Section 6 of the RFI Report.

## Soils

### Surface Soils (0 to 2 feet bgs)

Staining, odors or other evidence of petroleum-related impacts were noted in surface soils at nine of the 37 borings installed in EY1 as part of the OWSS Investigations and site-wide groundwater monitoring program. Other than naturally-occurring iron, antimony (161 mg/kg) and lead (977 mg/kg) were the only COCs detected above the applicable soil delineation criteria in surface soil samples. These detections were from one of the three surface soil sampling locations in EY1 (S0856A4 from MW152).

### Subsurface Fill Materials: (>2 feet bgs)

Staining, odors, or other evidence of petroleum-related impacts were noted in about half of the EY1 borings. In general, the thickness of the fill layer ranges from zero feet (at H0459) to at least 14 feet (at MW-148). Arsenic (38.7 mg/kg in soil sample S1429F4) and naphthalene (170 mg/kg in soil sample SB0281SC) were the only COCs detected above the applicable delineation criteria in any of the 19 subsurface fill samples, other than naturally-occurring iron. Arsenic (38.7 mg/kg) is well within the normal range for soils, particularly glauconitic soils in the Coastal Plain (Saunders, 2003). Acetone (110 mg/kg) was detected above the IGWSCC (100 mg/kg) in one sample from MW-152 (S0856F3); however, this sample was collected from below the water table, so this criterion would not be applicable.

## Native Soils

A clay/peat layer underlies the fill material at depths ranging from zero feet to at least 14 feet in Investigation Area EY1. No evidence of potentially impacted soils was noted in native materials in any of the EY1 borings, and no COCs except for naturally-occurring iron were detected above the soil delineation criteria in any of the three native soil samples collected from EY1. Therefore, potentially impacted soils in EY1 have been vertically delineated.

## Groundwater

As discussed in detail in Section 8 of the RFI Report, and shown on Table A.4.12, a number of analytes were detected above the applicable groundwater criteria in the hydropunch samples collected during the Phase I OWSS, although few exceedances were noted during the Phase II OWSS in EY1. These samples were collected using traditional hydropunch methodology (Phase I) and/or porous media (Phase II), and based on a comparison of hydropunch samples to samples from nearby monitoring wells, SVOC and metals data are not considered to be representative of ambient groundwater conditions. Benzene (ranging from 6 µg/L at HP0056 to 24,000 µg/L at HP0044) was detected above the applicable groundwater criterion in five of the thirteen Phase I OWSS hydropunch samples collected in 1996. It was not detected above the applicable groundwater criterion in any of the four Phase II OWSS samples collected in 1999.

The only organic compounds detected in the monitoring wells installed during the Full RFI in this part of the East Yard were benzene (100 µg/L) and 2-methylpentane (180J µg/L), which were detected in the October 2002 sample from MW-146; and bis(2-ethylhexyl)phthalate (310 µg/L) which was found in the sample from MW-152. Arsenic (79.2 µg/L, 13.6 µg/L and 12 µg/L) was detected above the applicable groundwater criteria in the October 2002 sample from MW-146, and in April 2003 samples from MW-173 and MW-174, respectively.

## Summary

LNAPL Area EY1 is located in the southern portion of EY1, and has been fully delineated, as discussed in detail in Section 7 of the RFI Report. Based on the relatively few exceedances of the applicable delineation criteria in soils and groundwater in samples from EY1, potentially-impacted soils noted in many of the borings at EY1 do not appear to be a significant source of ongoing contamination and are only found in the fill material. Nonetheless, the use of engineered controls/deed restrictions at EY1 will be evaluated further as part of the CMS, as will LNAPL area EY1 and potentially-impacted groundwater.

## EY2

Investigation Area EY2 is located in the northeastern portion of the East Yard and includes Tanks 766, 770, 772 and 773. EY2 is bordered by Investigation Areas EY1 and EY4 to the south and west, the Arthur Kill to the east and HESS Inc. to the north. The following samples have been installed to evaluate potential releases from the EY2 OWSS segment:

Constituents of Concern	Phase I OWSS		Phase II OWSS		Full RFI	
	Soil	Water	Soil	Water	Soil	Water
VOCs	0	0	2	21	3	1
SVOCs	0	0	2	21	3	1
Metals	0	0	2	21	3	1
TPH	0	0	2	0	0	0
Water Quality	0	0	0	0	0	1

A portion of the EY4 LNAPL area (which straddles the EY1/EY4 boundary) is located in the southeast portion of Investigation Area EY2, and is discussed in more detail in Section 7 of the RFI Report.

## Soils

### **Surface Soils (0 to 2 feet bgs)**

No evidence of potentially impacted soils was noted in surface soils installed in EY2 as part of the OWSS Investigations and site-wide groundwater monitoring program.

### **Subsurface Fill Materials: (>2 feet bgs)**

Staining, odors, elevated PID readings and/or other evidence of petroleum related impacts were noted in several of the EY2 borings. The fill layer ranges in thickness from five to 12 feet at Investigation Area EY2. Benzene (2.4 mg/kg) was detected above the IGWSCC, but below the RDCSCC in one of the three subsurface fill soil samples (S0504). S0504 is located within AOC 31 and impacted soils at this location will be included for further evaluation as part of AOC 31.

## Native Soils

A clay/sand layer underlies the fill material at depths ranging from approximately five to 12 feet bgs at Investigation Area EY2. No evidence of potentially impacted soils was noted in native materials in any of the EY2 borings, and no COCs except for naturally-occurring iron were detected above the soil delineation criteria in either of the two native soil samples collected from EY2. Therefore, potentially impacted soils in EY2 have been vertically delineated.

## Groundwater

Benzene (2 µg/L to 470 µg/L) was detected above the applicable groundwater criterion in six samples, arsenic and lead were detected above the applicable criteria in 1999 at six of the Phase II hydropunch samples collected. Other COCs, including arsenic, lead and several other metals and SVOCs that were detected relatively infrequently from this area, were also detected in the Phase II OWSS samples. These samples were collected using traditional hydropunch methodology (Phase I) and/or porous media (Phase II), and based on a comparison of hydropunch samples to samples from nearby monitoring wells,

SVOC and metals data are not considered to be representative of ambient groundwater conditions. No COCs were detected in the groundwater sample collected in April 2003 from MW-172. More detailed discussion of groundwater impacts in the EY2 Investigation Area can be found in Section 8 of the RFI Report.

## Summary

LNAPL Area EY4b is partially located in the southeast portion of EY2, and has been fully delineated, as discussed in detail in Section 7 of the RFI Report. Based on the relatively few exceedances of the applicable delineation criteria in soils and groundwater in samples from EY2, potentially impacted soils noted in some of the borings at EY2 do not appear to be a significant source of ongoing contamination and are only found in the fill material. Nonetheless, the use of engineered controls/deed restrictions at EY2 will be evaluated further as part of CMS, especially with regard to potential impacts in the vicinity of AOC 31, as will LNAPL Area EY4b and potentially impacted groundwater.

## EY3

Investigation Area EY3 is situated in the central portion of the East Yard and includes Tanks 750 through 752. EY3 is bordered by Investigation Area EY1 to the north, Investigation Area EY4 to the east, Investigation Areas EY5 and EY6 to the south, and the southeastern corner of the East Yard to the west. The following samples have been installed to evaluate potential releases from the EY3 OWSS segment:

Constituents of Concern	Phase I OWSS		Phase II OWSS		Full RFI	
	Soil	Water	Soil	Water	Soil	Water
VOCs	0	0	0	11	0	0
SVOCs	0	0	0	11	0	0
Metals	0	0	0	11	0	0
GC Fingerprint	0	0	0	1	0	0

LNAPL Area EY3 is located in the eastern portion of Investigation Area EY3, and the SWMU 42 LNAPL area and a portion of the EY1 LNAPL area are located in the western part of EY3.

## Soils

### Surface Soils (0 to 2 feet bgs)

Black staining and odors were noted in the surficial fill material at three locations (H0411, H0468 and H0477) in EY3.

### Subsurface Fill Materials (>2 feet bgs)

A total of fourteen hydropunch borings were installed during the Phase II OWSS Investigation in EY3. Measurable LNAPL was detected in two of the borings, including

H0475 and H0476, which led to the identification of the EY3 LNAPL area. Petroleum impacted soils were noted in four additional borings, including H0467, H0472, H0473 and H0477. Black staining, hydrocarbon odors, and/or elevated PID readings (greater than 100 ppm) were observed in five borings (H0411, H0468, H0470, H0471 and H0474). As discussed in greater detail in Section 7 of the RFI Report, it appears that at one time the areas with measurable LNAPL were much more extensive, and that these LNAPL areas (e.g., EY1, SWMU 42 and EY3) have decreased considerably over the past few years.

### **Native Soils**

A clay layer underlies the fill material at depths ranging from approximately 4.5 feet to 14 feet bgs at the EY3 Investigation Area. Hydrocarbon odors, elevated PID readings and other evidence of petroleum-impacted soils were noted in native soils collected from EY3.

### **Groundwater**

As discussed in more detail in Sections 7 and 8 of the RFI Report, it is probable that benzene, naphthalene and several other organic compounds that were detected above the delineation criteria in groundwater are associated with the SWMU 42 and EY3 LNAPL areas. Several metals, including arsenic and lead, were also detected above the delineation criteria in most of the EY3 water samples. These samples were collected using porous media (Phase II), and based on a comparison of hydropunch samples to samples from nearby monitoring wells at selected locations throughout the Refinery, SVOC and metals data are not considered to be representative of ambient groundwater conditions. The distribution of COCs in groundwater is discussed in greater detail in Section 8 of the RFI Report.

### **Summary**

The three LNAPL areas (EY1, EY3 and SWMU 42) located within the EY3 Investigation Area have been fully delineated, as described in Section 7 of the RFI Report. These three areas, as well as potentially impacted groundwater within EY3, will be evaluated further as part of the CMS.

### **EY4**

Investigation Area EY4 is situated in the southeastern portion of the East Yard. EY4 is bordered by Investigation Areas EY1 and EY3 to the west, Investigation Area EY2 to the north, the Arthur Kill to the east, and ASARCO to the south. The following samples have been installed to evaluate potential releases from the EY4 OWSS segment:

Constituent of Concern	Phase I OWSS		Phase II OWSS		Full RFI	
	Soil	Water	Soil	Water	Soil	Water
VOCs	0	0	10	30	6	2
SVOCs	0	0	10	30	6	2
Metals	0	0	9	29	6	2
GC Fingerprint	0	0	0	2	0	0
TPH	0	0	9	0	0	0
Water Quality	0	0	0	0	0	2

A total of 46 borings were installed in EY4 during the Phase II OWSS Investigation of EY4. Measurable LNAPL was detected in five of the borings (H0350, H0380, H0382, H0383 and H0401), which led to the identification of LNAPL Areas EY4a and EY4b.

#### **Surface Soils (0 to 2 feet bgs)**

Staining, odors and other evidence of petroleum impacted soils were observed in surface soil samples from EY4. Benzo(a)pyrene (1.3J mg/kg), two other PAHs and antimony (15.6 mg/kg) were detected above the applicable soil delineation criteria in one of the two surface soil samples (S0855A4) collected from EY4. Arsenic (32.7 mg/kg and 60.9 mg/kg) was detected above the applicable delineation criterion in both surface soil samples (S0846A4 and S0855A4, respectively). Arsenic (32.7 mg/kg and 60.9 mg/kg) is well within the normal range for soils, particularly glauconitic soils in the Coastal Plain (Saunders, 2003).

#### **Subsurface Fill Materials (>2 feet bgs)**

Staining, odors and other evidence of petroleum impacted soils were observed in subsurface fill material in many of the borings in EY4. The fill layer generally ranges between five and 11 feet thick in the EY4 Investigation Area. A total of 11 subsurface fill material samples were collected from EY4.

Benzene (ranging from 1.7 to 29 mg/kg), benzo(a)pyrene (ranging from 1.3J to 38 mg/kg), several other PAHs, arsenic (ranging from 24.4 mg/kg to 69.9 mg/kg), and lead (609 mg/kg to 831 mg/kg) were detected above the applicable soil delineation criteria in soil samples collected within the EY4 area. Antimony (40.4 mg/kg) was detected above the applicable soil delineation criterion in one sample (S0499B4), which also contained benzene, arsenic and lead above the applicable soil delineation criteria. Most of the organic compounds above the soil delineation criteria were detected in samples located within or adjacent to either LNAPL Area EY4A or EY4B. Although exceedances of arsenic are more widespread, arsenic (ranging from 24.4 mg/kg to 69.9 mg/kg) is well within the normal range for soils, particularly glauconitic soils in the Coastal Plain (Saunders, 2003).

## Native Soils

Native clay/sand is generally encountered between five and 11 feet bgs in the EY4 Investigation Area. No evidence of potentially impacted soils was noted in native materials in any of the EY4 borings, and no COCs except for naturally-occurring iron were detected above the soil delineation criteria in either of the two native soil samples collected from EY4. Therefore, potentially impacted soils in EY4 have been vertically delineated.

## Groundwater

As discussed more fully in Section 8 of the RFI Report, there were numerous exceedances of organic compounds and metals, including benzene, PAHs, arsenic and lead in the hydropunch samples collected during the Phase II OWSS. These samples were collected using porous media and, based on comparisons of hydropunch samples to samples from nearby monitoring wells at selected locations throughout the Refinery, SVOC and metals data are not considered to be representative of ambient groundwater conditions. Only two of the samples from the monitoring wells (MW-141 and MW-149) installed during the Full RFI contained benzene (29 µg/L and 9 µg/L, respectively) above the groundwater delineation criteria, and only one groundwater sample (MW-149) contained arsenic (41.1 µg/L) above the applicable groundwater delineation criterion. The distribution of organics and metals in groundwater is discussed in greater detail in Section 7 of the RFI Report.

## Summary

The two LNAPL areas (EY4a and EY4b) located within the EY4 Investigation Area have been fully delineated, as described in Section 8 of the RFI Report. These three areas, as well as potentially impacted soils and groundwater within EY4, will be evaluated further as part of the CMS.

## EY5

Investigation Area EY5 is situated in the southern portion of the East Yard and includes the asphalt plant and asphalt air blowing facilities. EY5 is bordered by Investigation Areas EY3 and EY5 to the west, Investigation Area EY4 to the north and east, and ASARCO to the south. LNAPL area AOC 28 is located within the EY5 Investigation Area.

The following samples have been installed to evaluate potential releases from the EY5 OWSS segment:



Constituents of Concern	Phase I OWSS		Phase II OWSS		Full RFI	
	Soil	Water	Soil	Water	Soil	Water
VOCs	0	0	0	12	3	1
SVOCs	0	0	0	12	3	1
Metals	0	0	0	12	3	1
Water Quality	0	0	0	0	0	1

A total of 12 hydropunch samples were collected from EY5 during the Phase II OWSS, and one monitoring well was installed during the Full RFI to characterize this segment of the OWSS. The lithologic and analytical data for these samples are summarized on Table A.4.12.

### Surface Soils (0 to 2 feet bgs)

In general, there was no evidence of petroleum related impacts in surface soils at EY5, although some staining and other evidence of petroleum impacts were noted in the soil boring for MW-143. The surface soil sampled from this boring (S0847A2/A4) contained benzo(a)pyrene (1.1J mg/kg) and arsenic (28.9 mg/kg) above the applicable soil delineation criteria. Arsenic (28.9 mg/kg) is well within the normal range for soils, particularly glauconitic soils in the Coastal Plain (Saunders, 2003).

### Subsurface Fill Materials (>2 feet bgs)

In general, there was no evidence of petroleum related impacts in surface soils at EY5, although some staining and other evidence of petroleum impacts were noted in the soil boring for MW-143, and elevated PID readings (60 ppm and 77 ppm) at H0372 and H0373, respectively. The thickness of the fill material ranges from two feet (H0375) to nine feet (at H0365, H0367 and H0374). Benzo(a)pyrene (0.69J mg/kg), antimony (22.6J mg/kg) and arsenic (41.7 mg/kg) were the only COCs detected above the applicable soil delineation criteria in the subsurface soil sample (S0847B3) collected from EY5.

### Native Soils

Native clay/sand is generally encountered between two to nine feet bgs in the EY5 Investigation Area. No evidence of potentially impacted soils was noted in native materials in any of the EY5 borings, and no COCs except for naturally-occurring iron were detected above the soil delineation criteria in the native soil sample (S0847C4) collected from EY5. Therefore, potentially impacted soils in EY5 have been vertically delineated.

### Groundwater

Very low concentrations of benzene (2 µg/L) were detected at H0371 and H0373. Lead and arsenic were also detected above the delineation criteria in many of the other hydropunch samples from EY5. These samples were collected using porous media and, based on comparisons of hydropunch samples to samples from nearby monitoring wells

at selected locations throughout the Refinery, SVOC and metals data are not considered to be representative of ambient groundwater conditions. Only arsenic (104 µg/L) was detected above the groundwater delineation criterion in the October 2002 sample from MW-143. A more detailed discussion of groundwater quality is provided in Section 8 of the RFI Report.

## Summary

LNAPL area AOC 28 is located within the EY5 Investigation Area and has been fully delineated, as described in Section 7 of the RFI Report. This LNAPL area, as well as potentially impacted soils and groundwater within EY5, will be evaluated further as part of the CMS.

## EY6

Investigation Area EY6 is situated in the southern portion of the East Yard and includes Tanks 700 through 703. EY6 is bordered by Investigation Areas EY3 and EY5 to the north and east, the southwestern corner of the East Yard and State Street to the west, and ASARCO to the south.

The following samples have been installed to evaluate potential releases from the EY6 OWSS segment:

Constituents of Concern	Phase I OWSS		Phase II OWSS		Full RFI	
	Soil	Water	Soil	Water	Soil	Water
VOCs	0	0	0	12	3	1
SVOCs	0	0	0	12	3	1
Metals	0	0	0	12	3	1
Water Quality	0	0	0	0	0	1

A total of 12 hydropunch samples were collected from EY6 during the Phase II OWSS, and one monitoring well was installed during the Full RFI to characterize this segment of the OWSS. The lithologic and analytical data for these samples are summarized on Table A.4.12.

### Surface Soils (0 to 2 feet bgs)

Black staining was observed at one to two feet bgs in the soil boring for MW-153; however, naturally-occurring iron was the only analyte to exceed the delineation criteria in the soil sample from this interval.

### Subsurface Fill Materials (>2 feet bgs)

No evidence of petroleum-related impacts was noted in subsurface soils in any of the EY6 soils, and there were no exceedances of the soil delineation criteria in the subsurface fill sample (S0857B3) from EY6.

## **Native Soils**

Native clay/sand is generally encountered between 5 to 9.5 feet bgs in the EY6 Investigation Area. No evidence of potentially impacted soils was noted in native materials in any of the EY6 borings, and no COCs except for naturally-occurring iron were detected above the soil delineation criteria in the native soil sample (S0857F3) collected from EY6.

## **Groundwater**

Metals, including antimony, arsenic and lead were the only analytes to exceed the delineation criteria in groundwater hydropunch samples collected from EY6. These samples were collected using porous media and based on comparisons of hydropunch samples to samples from nearby monitoring wells at selected locations throughout the Refinery, SVOC and metals data are not considered to be representative of ambient groundwater conditions. The only metal that exceeded the applicable groundwater criterion in the October 2002 sample from MW-153 was antimony (69.2 µg/L). A more detailed discussion of groundwater quality is provided in Section 8 of the RFI Report.

## **Summary**

Limited impacts have been found in either soils or groundwater samples from the EY6 Investigation Area other than one exceedance of the applicable groundwater delineation criterion for antimony (69.2 µg/L) in the groundwater sample from MW-153. Nonetheless, potentially impacted groundwater within EY6 will be evaluated further as part of the site-wide groundwater evaluation in the CMS.